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DEVICE FOR COOLING ROLLING STOCK WITHIN THE COOLING LINE OF A ROLLING MILL

The invention concerns a device for cooling rolling stock within the cooling line of a rolling mill, especially a hot strip rolling mill, in which stationary water spray devices are installed below the rolling stock between the rollers of a roller table, and spray bars held on support levers are installed above the rolling stock, wherein the support levers are supported by a tubular, rotationally driven and water-fed articulated tube that extends parallel to the longitudinal axis of the roller table, with a central water feed pipe and an automatic control device with associated on-off valves for switching the cooling water on and off.

Devices for cooling rolling stock are permanent parts of every rolling mill. They have become more important since certain metallurgical states, e.g., grain sizes, and the high working stress of the rolled product associated with these

metallurgical states have been strived for by influencing the transformation of the steel.

For example, EP 0 178 281 B1 describes equipment for cooling a metal product with flat upper and lower sides, especially sheet metal, which is moved on a roller conveyor, wherein coolant for the lower side is fed into the gaps formed between the rollers of the roller conveyor, and another device is provided above the rolling stock, whose distance from the rolling stock can be varied. Disadvantages of this well-known cooling equipment are the comparatively high material expense and especially the costly on-site installation work, which results in relatively high construction costs.

DE 198 43 038.8 describes a device for cooling rolling stock, in which spray bars that deliver cooling water from above are supported in such a way that they can swivel and are partially balanced by counterweights to simplify the operation. By combining the cooling water feed lines, the resulting installation costs can be favorably affected.

The objective of the invention is to further increase the maximum cooling capacity that can be achieved, but at the same time to shorten the length of the roller table required for this

to obtain a compact design and a high cooling capacity.

This objective is achieved by the measures specified in Claim 1. Modifications of the cooling device of the invention are specified in the dependent claims.

The features of the invention are explained in detail in the following description of the embodiment of the invention illustrated in the drawings.

-- Figure 1 shows a longitudinal section of the compact design of the cooling system with a conveyor roller table, a strip guide and longitudinal strip spraying devices.

-- Figure 2 shows a cross section of the cooling system in Figure 1 with conveyor roller table, strip guide, and swiveling device for the upper spray bars.

-- Figure 3 shows the same cross section of the roller table as in Figure 2 but drawn to a slightly smaller scale and with the spray bar raised.

-- Figure 4 shows a top view of a section of the roller table with a system for guiding the strip.

-- Figure 5 shows a schematic vertical section of a spray bar with spray tube plate and spray tubes.

-- Figure 6 shows a vertical longitudinal section of one of

the lower cooling bars.

-- Figure 7 shows a schematic cross section of two adjacent rollers of a roller table with lower cooling bars with spray tubes provided between and under them.

Figure 1 shows a roller table modified into a compact cooling device. Lower cooling bars 2 are seen slightly below the gaps between the rollers of this roller table 1. Spray bars 3, which are terminated at the bottom by interchangeable spray tube plates 4 with spray tubes, are shown above the roller table. Swiveling spray guard plates 5 articulate with the spray bars 3 and are designed to protect the surrounding area from sprayed water and to ensure that used spray water flows downward. The drawing also shows strip guide straightedges 6, which serve to align and centrally guide the hot strip running into the roller table.

The arrangement of the cooling bars, spray bars, and strip guide straightedges is shown in detail in Figure 2, which is drawn to a larger scale and shows a cross section of the roller table 1 in the center plane of a lower cooling bar.

The cooling bar 2 is closed at both ends by caps 7, which can be removed, for example, for cleaning. The cooling bar 2 is

fed through a cooling water pipe 8 via a manifold 9. The rollers 10 of the roller table 1 are provided with long, slender pins 11, which support the rollers in bearings and transmit the drive from the roller table motors 12. The rollers 10 are arranged with very narrow spacing, and the spray tubes 13 of the cooling bar 2 fit into the narrow spaces between them. However, this allows only small amounts of cooling water to flow off between the rollers 10; all the more space is offered for the water to flow off between the long, slender pins 11 of the rollers 10.

In this connection, the strip guide straightedges 6 are shown again in this drawing. The guide straightedge shown on the left is pulled back for maximum strip widths or for a home position and thus opens the area of the pins of the rollers for water to flow off from the very start. On the other hand, the guide straightedge shown on the right is pushed extremely far forward and thus largely covers the runoff route formed between the pins 11 of the rollers 10. Therefore, during practical operation, when the strip is run in, the strip guide straightedges 6 are set to the width of the strip that is running in, and after the strip has been run in, the cooling

system is turned on, and the strip guide straightedges are pulled back into their home position of maximum opening.

The placement of the upper spray bar 3 is also shown in the drawing. A rotating articulated tube 15, which is fed with cooling water in the axial direction, is supported by means of one or more stands 14. Tubular support arms 16, into which the cooling water of the articulated tube 15 can enter, are connected to the articulated tube 15. Two parallel spray bars 3 are connected to each of these support arms and are supplied with cooling water through the tubular support levers 16. On the underside, the spray bars 3 are supplemented by interchangeable and adaptable spray tube plates 4, and the free ends support the articulated spray guard plates 5. Each of the support levers is supported by a hydraulic cylinder 17 and can be swung upward by the hydraulic cylinder from its working position shown in Figure 2 into the position shown in Figure 3 to perform repairs and inspections or to allow strips to be removed from the roller table.

Figure 4 shows a top view of the strip guide straightedges 6 of the roller table. The two adjusting devices 18 for the guide straightedges 6 have adjusted to a narrow strip width, so

that the straightedges are above the cylindrical surfaces of the rollers 10 themselves: As has already been explained, after the strip has been run in, the guide straightedges 6 are opened to their maximum extent, so that the relatively large spaces formed between the pins 11 of the rollers 10 are able to carry off the cooling water delivered by the spray bars 3 and possibly by the cooling bars 2.

The design of the spray bars 3 is illustrated in Figure 5, which shows a cross section on a larger scale. The drawing shows a spray tube plate 4 mounted below the spray bar 3 and a number of spray tubes 20. As the enlarged detail drawings show, the free, water-carrying mouth region 21 of the spray tubes 20 is expanded like a funnel to allow the water flowing in to be carried without throttling. On the other hand, the discharge region 22 is either cylindrical or constricted, usually only slightly, but in any event to the extent required to achieve the desired spray velocity. There are several mounting possibilities: The spray tubes 20 can be mounted in the spray tube plate 4, or they can be designed to be replaceable, in case a change or replacement becomes necessary due to wear or due to the need to use different dimensions.

Figure 6 again shows one of the lower cooling bars 2 in a side view. The removable caps 7 that seal the cleaning or inspection opening and the manifold 9 for connecting the cooling water pipe 8 of Figures 2 and 3 are also shown here.

However, as especially Figure 7 shows, the space formed between two adjacent rollers 10 of the roller table 1 is very narrow, so that the supply of cooling water from below and the drainage of the cooling water running off from above become critical in such a compact arrangement. This problem is solved here by arranging the actual body of the cooling bar 2 below the center horizontal lines of the rollers 10 and at the same time providing a pear-shaped design of the cross section of the cooling bar in the direction of the streamlined body. This body is terminated above by a retaining strip 23, whose bores hold the spray tubes 13, which terminate at their upper end in a nozzle 24 that determines their spray pattern.

As Figure 1 shows, the compact cooling system is supplemented by longitudinal spray devices 25 and 26, which can be swiveled and switched, at the inlet and outlet ends. These ensure that the cooling water present on the upper side of the strip due to the delivery of abundant cooling water cannot flow

or be conveyed by the strip into the area of the technological measuring instruments, where they would distort or falsify the measurement results. These longitudinal spray devices 25 and 26 consist of swinging flaps 27 and 28 with nozzle tubes 29 and 30. When the strip is being run in, the flaps are swung up to ensure trouble-free passage of the strip. The flaps 27, 28 are then lowered for operation, and the nozzle tubes 29, 30 are turned on. After the flaps and nozzle tubes have been lowered, the nozzles are located directly above the surface of the strip to ensure effective nozzle jet action. The flaps protect the nozzles and can turn upward in the event of problems with the strip flow, e.g., looping, without any significant damage to the longitudinal spray devices.

Reference Numbers

1	roller train
2	lower cooling bar
3	upper spray bar
4	spray tube plate (3)
5	spray guard plate
6	strip guide straightedge
7	cap (2)
8	cooling water pipe (2)
9	manifold (2)
10	roller (1)
11	pin (10)
12	motor (10, 11)
13	spray tube
14	stand
15	rotating articulated tube
16	support lever (15)
17	hydraulic cylinder (16)
18	adjusting device (6)
19	stop (6)

20	spray tubes
21	mouth region
22	discharge region (19)
23	retaining strip (2)
24	nozzles (13)
25, 26	longitudinal spray systems
27, 28	flaps (25, 26)
29, 30	nozzle tubes (25, 26)